MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

TAI2151 – ARTIFICIAL INTELLIGENCE FUNDAMENTALS

(All Sections/Groups)

1 June 2017
9.00am – 11.00am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **5** pages with **5** questions only.
2. Attempt **ALL FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

(a) Many people assert that the Turing test is the only legitimate test of machine intelligence. What is a Turing test? What is the most important premise/condition to pass the Turing test? (3 marks)

(b) The most basic form of agent is purely reactive, whereas an agent based on planning or search is entirely deliberative. Describe the differences between reactive and deliberative agents. (2 marks)

(c) Classify with justification the tic-tac-toe task environment according to the following properties:

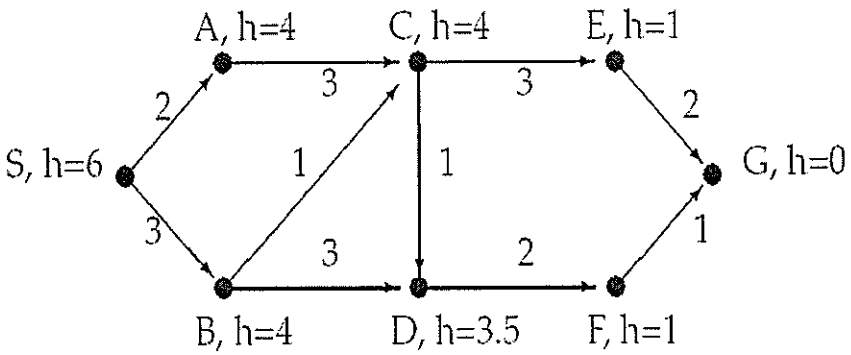
(i) Is it fully or partially observable? (1 mark)
(ii) Is it deterministic or stochastic? (1 mark)
(iii) Is it episodic or sequential? (1 mark)
(iv) Is it static, dynamic or semi-dynamic? (1 mark)
(v) Is it discrete or continuous? (1 mark)

Continued....

Question 2

(a) A* search generates an optimal solution provided it is given an admissible heuristic. What is an admissible heuristic? (3 marks)

(b) The graph below represents a problem space. Nodes are labelled with a letter and the value of a heuristic function ***h*** for the node. Edges are labelled with the cost of traversing the edge. Suppose we want to use the Greedy Search algorithm on the graph to find the path from node ***S*** to node ***G***.



(i) Simulate running the Greedy Search algorithm on the graph by filling in lines in the table below, showing the ***h*** value of each node on the queue. If you find a new path to a node already on the queue, update its cost (using the lower ***h*** value) instead of adding another copy of that node to the queue. Keep the queue sorted. When two or more nodes are generated at the same time, the selection is based on the alphabetical order of their labels. (5 marks)

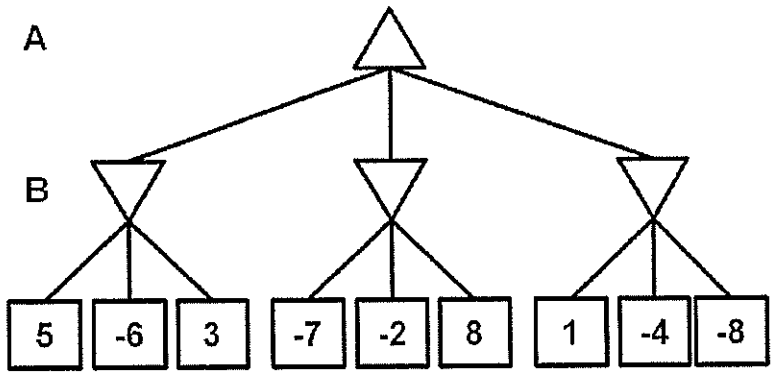
Iteration	Node Visited / Expanded	Priority Queue (aka Fringe, Open List) Notation for a Node is NAME(H value)
0	--	S(6)
1	S	A(4), B(4)
2		
3		
4		
5		
6		

(ii) For the solution found by Greedy Search, give the cost and sequence of nodes comprising the path. (2 marks)

Continued....

Question 3

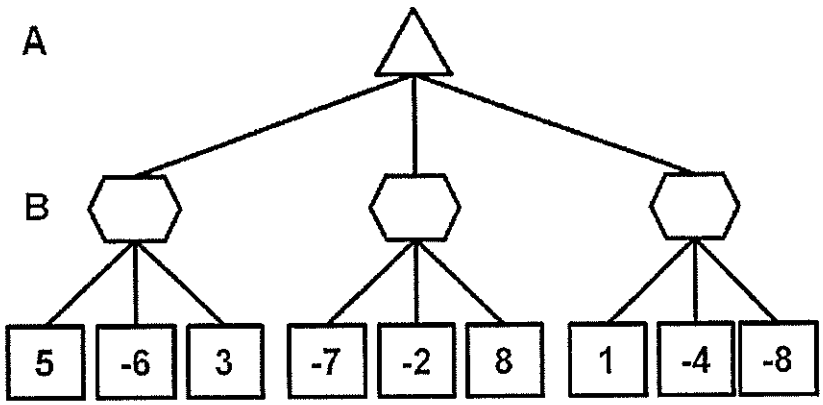
Consider the following zero-sum game, in which the utilities $U_A(s)$ are shown for the first player (A). Assume the second player (B) is a minimizer: B holds the opposite utilities to A, $U_B(s) = -U_A(s)$. In this case, B's maximization of U_B is equivalent to minimization of U_A (i.e. the computation is standard minimax).



(a) In each node, write $U_A(s)$, the (minimax) utility of that state for player A, assuming that B is a minimizer. (2 marks)

(b) Cross off any nodes which will be skipped by alpha-beta pruning, assuming left-to-right ordering. (3 marks)

Assume now that B is not a minimizer, but a balancer. A balancer does not try to minimize A's score, but rather wishes the outcome of the game to be as balanced as possible. Formally, assume B's utility for a state s is defined as $U_B(s) = -|U_A(s)|$. The game tree is shown here, with hexagons indicating player B's control.



(c) In each node, write $U_A(s)$, the utility of that state for player A, assuming that B is a balancer. (2 marks)

(d) Consider pruning children of a B node in this scenario. On the tree above, cross off any nodes which can be pruned, again assuming left-to-right ordering. (3 marks)

Continued....

Question 4

You are given the following predicates:

fist(X) = X is a student of FIST
mmu(X) = X is a student of MMU
smart(X) = X is smart

(a) Translate the following English sentences into First-Order Logic statements using the predicates above:
(i) Ali is a student of FIST.
(ii) All students of FIST are students of MMU.
(iii)All students of MMU are smart. (2 marks)

(b) Convert the First-Order Logic statements obtained in (a) into Conjunctive Normal Form. (2 marks)

(c) Use resolution refutation to prove that Ali is smart. (6 marks)

Continued....

Question 5

We would like to learn a decision tree for deciding whether or not you will like a given restaurant. Assume we have chosen two types: Price and Type, where Price has three possible values: Low (L), Medium (M), and High (H); and Type has two possible values: Hamburger (H) and Vegetarian (V). Consider the following training set consisting of five examples:

Example	*Attributes*		*Class*
	Price	**Type**	
1	L	H	+
2	L	V	+
3	M	H	-
4	M	V	+
5	H	V	-

For your information, $log_2\ 1 = 0$, $log_2\ 2 = 1$, $log_2\ 3 = 1.6$, $log_2\ 4 = 2$, $log_2\ 5 = 2.3$
Also, $log(x/y) = log\ x - log\ y$

(a) Using the Max Gain method, what is the best attribute for the root node of the decision tree? Show all your work. (8 marks)

(b) Construct the entire decision tree. (2 marks)

End of Paper